MinXray *HF100H*

High Frequency Portable Medical X-ray unit

Installation and Operating Instructions

Version 2.0

CAUTION;

Federal law restricts this device to sale and use by or on the order of a licensed physician.

MinXray, Inc.
3611 Commercial Avenue
Northbrook, Illinois 60062-1822
U.S.A.

Tel: 1-847-564-0323
Toll Free Tel: 1-800-221-2245 (U.S. and Canada)
Fax: 1-847-564-9040
Email: service@minxray.com
www.minxray.com

MINXRAY INC

TABLE OF CONTENTS

Introduction 1

Certifications 2

Components 3

Main Parts 4

Control Panel 5

Warning Statements, Figures and Symbols 6

Installation Instructions

- Unpacking 7
- Assembly Instructions 7
- Pre-Operational Required Testing 8
- Installation Check List 11

Operation Instructions

- Operation 12
- Safety Precautions 14
- Maintenance 14

Specifications 16

Dimensions 17

Schematic Diagram 18

X-ray Tube Data 19

INTRODUCTION

The MinXray *HF100H* is a mono-block type high frequency portable x-ray unit designed for general purpose medical radiography. The *HF100H* can be used with conventional x-ray film or with digital imaging media. It consists of an x-ray tubehead/control attached to which is a continuously adjustable light beam collimator. A trunnion enables the *HF100H* to be attached to a suitable stand, such as the MinXray XGS series of portable mobile stands. The *HF100H* is supplied with a detachable AC power cord, and a detachable exposure cord with a 2-stage exposure switch.

CARELESS OR IMPROPER USE OF X-RAY EQUIPMENT CAN BE EXTREMELY HAZARDOUS. It is imperative that this equipment be operated and serviced only by trained personnel familiar with the safety precautions required to prevent excessive exposure to primary X-ray radiation, the dangers of exposure to X-ray radiation, and the proper use of the equipment discussed in this manual.

All personnel authorized to operate or service this equipment should be fully acquainted with the established maximum permissible doses, safety recommendations, and procedures derived from the following sources:

A. National Council on Radiation Protection Report No.33 (Medical X-Ray and Gamma Ray Protection for Energies up to 10 MEV - Equipment Design and Use); from NRCP Publications; P.O. Box 30175, Washington, D.C. 20014.

B. National Bureau of Standards Handbook No.76 (Medical X-Ray Protection up to Three Million Volts); from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20401.

C. All documents relating to the Performance Standard for Diagnostic X-Ray Systems, 21 CFR Subchapter J, Part 1020; obtainable from FDA Center for Devices and Radiological Health, Department of HHS, 2098 Gaither Road, Rockville, MD 20850.

D. State and local regulations governing radiation protection and the use of diagnostic X-ray equipment.

E. Requirements of the user's in-house radiation protection program.

F. Instructions and precautionary notices of this manual.

Although this equipment incorporates protective design features for limiting both the direct (primary) x-ray beam and the secondary radiation produced by this beam, design factors alone cannot prevent human carelessness, negligence, or lack of knowledge. This apparatus is sold with the

understanding that the user assumes sole responsibility for radiation safety and that MinXray, Inc., its agents and representatives, do not accept any responsibility for:

A. Injury or danger to patient or other personnel from x-ray exposure.

B. Overexposure due to poor operating techniques or procedures.

C. Equipment not properly serviced or maintained in accordance with this manual.

D. Equipment which has been modified or tampered with in any way.

E. Equipment that has been connected to input voltage other than the voltage specified on the rating label affixed to the x-ray unit.

CERTIFICATIONS

THIS PRODUCT CONFORMS TO ALL APPLICABLE DHHS RADIATION STANDARDS OF 21 CFR SUBCHAPTER J AS OF THE DATE OF MANUFACTURE

THIS PRODUCT IS MADE IN JAPAN BY A MANUFACTURER CERTIFIED ACCORDING TO THESE INTERNATIONAL STANDARDS: ISO9001, ISO13485, EN46001.

COMPONENTS

1. X-ray Unit (Model *HF100H*)	1 set
2. Power Cord	1 pc.
3. Hand-held Exposure Switch and Cord	1 pc.
4. Instruction Manual (X-ray unit)	1 pc.
5. Instruction Manual (Collimator)	1 pc.

OPTIONAL COMPONENTS

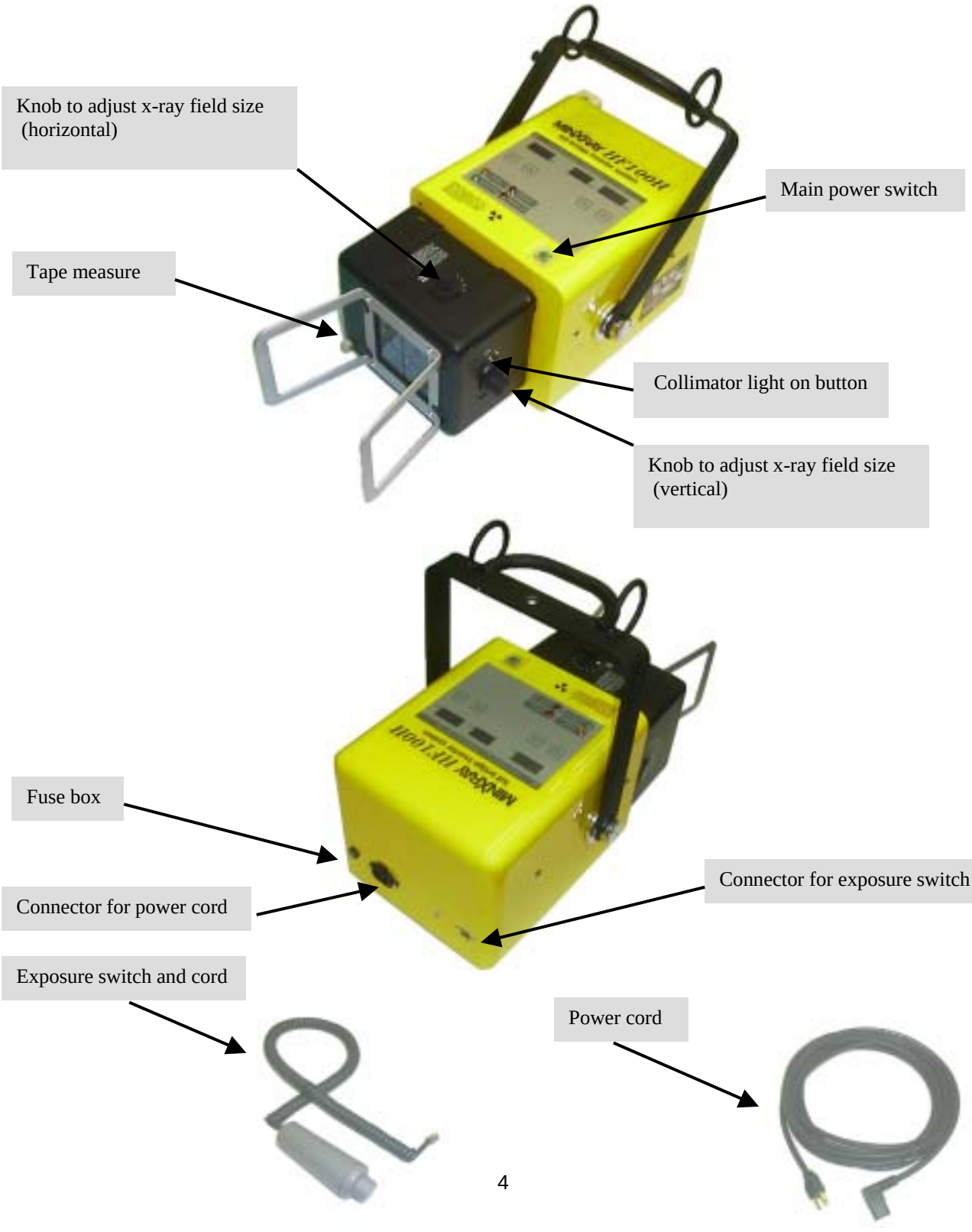
Mobile Stand (Model XGS Series)

Carrying Case (Model HF100HCC)

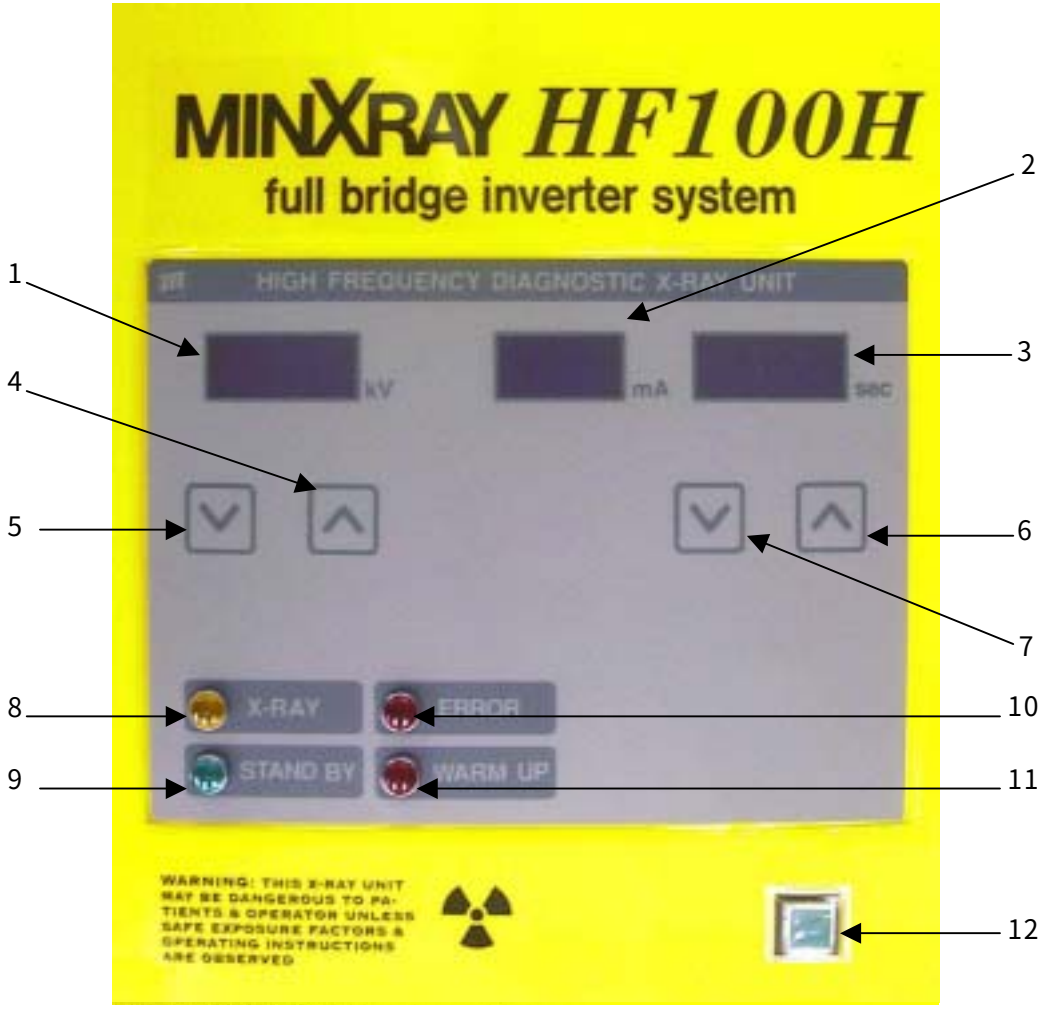
System Transport Case (Model HF100HSTC)

MINXRAY INC

MAIN PARTS OF MinXray *HF100H*



CONTROL PANEL



1. kV Indicator
2. mA Indicator
3. Exposure Time Indicator
4. kV Adjustment Button (+)
5. kV Adjustment Button (-)
6. Exposure Time Adjustment Button (+)
7. Exposure Time Adjustment Button (-)
8. X-ray Indicator
9. Stand By Indicator
10. Error Indicator
11. Warm Up Indicator
12. Main Power Switch

Warning Statements, Figures and Symbols

WARNING: THIS X-RAY UNIT MAY BE DANGEROUS TO PATIENT & OPERATOR UNLESS SAFE EXPOSURE FACTORS & OPERATING INSTRUCTIONS ARE OBSERVED

DANGER: HIGH VOLTAGE. NO USER SERVICEABLE COMPONENTS INSIDE. REFER SERVICE TO QUALIFIED SERVICE TECHNICIAN. FOR CONTINUED PROTECTION AGAINST HAZARDOUS CONDITION, REPLACE FUSE WITH SAME TYPE AND RATING ONLY.

Radiation warning symbol

MinXray *HF100H*

INSTALLATION INSTRUCTIONS

Unpacking

The MinXray *HF100H* consists of an x-ray generator (tubehead/control), continuously adjustable light beam collimator, mounting trunnion, exposure cord with 2-stage exposure switch, and AC power cord.

If a stand is purchased with the *HF100H*, such as the MinXray XGS series of gas spring portable mobile stands, instructions for assembly of the stand and the attachment of the *HF100H* are included with the stand.

This equipment was shipped in perfect condition. When the equipment is received, each shipping container should be carefully examined for any evidence of mishandling during shipment. Note its condition; if abnormal, carefully unpack all parts and examine for damage. If any damage is noted, immediately report it to the carrier in the proper manner; by personally calling it to attention by phone where possible, and filing a written report. Save all packing material for inspection by the carrier. If this equipment arrives with any damage, it is your responsibility to report to the carrier and file a claim.

All printed material supplied with the *HF100H* and the XGS series stand should be saved for reference during installation and operation.

Assembly Instructions

1. Attach the *HF100H* to a stand designed or suitable for use with this x-ray unit, according to the instructions provided with the stand. The MinXray XGS series of gas spring portable mobile stands is designed specifically for use with the *HF100H* x-ray unit. Once the *HF100H* is properly attached to the model XGS stand, it can remain attached for use and transport.

2. Connect the AC power cord to the socket on the back of the HF100H. Note the rated voltage of the *HF100H* before connecting it to an AC power source.

3. Connect the exposure cord to the RJ11 telephone-type socket on the back of the *HF100H*.

PRE-OPERATIONAL REQUIRED TESTING

The following test is the responsibility of the dealer or qualified end-user technical personnel, and must conducted without fail. Fill out the checklist for this report, when installation of the x-ray unit is complete.

1. EXPOSURE TIMER

1-1 Test method:

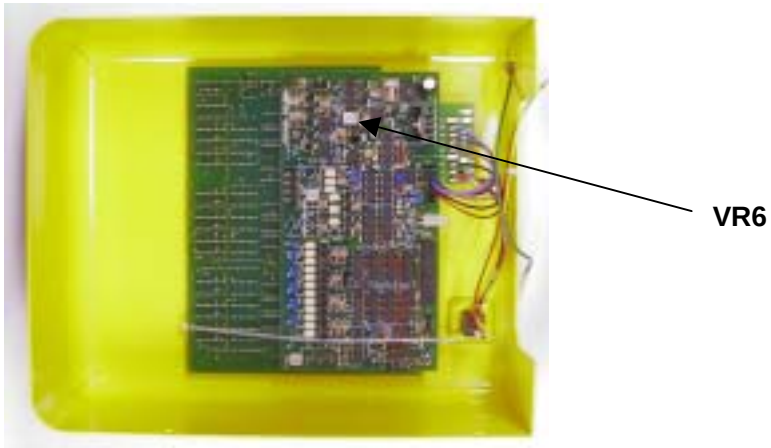
1. Set *HF100H* exposure timer to 0.02 sec.
2. Set *HF100H* output to 100 kV.
3. Set NERO to the following settings.
   SID: 18 inches; Wheel range: 70 ~ 120 kV; Sensitivity: Low; Phase select: 3Ø;
   Measurement mode: SGL; X-ray values: 100 kV, 0.08 sec.
4. Make exposure and read the measured value of exposure time on the NERO.
5. Measure value of exposure time at following settings with same procedure: 0.08, 0.1, 0.12, 0.2, and 1.00 sec.

1-2 Instruments: NERO Model 6000M x-ray beam analyzer
Manufactured by Victoreen, Inc. or equivalent

1-3 Rejection limit: ±10%+1 msec.

If the timer needs adjustment: (1) remove the 4 screws on the side of the top cover of the *HF100H*, and lift the top off of the body of the unit; (2) adjust the potentiometer "VR6" on the printed circuit board M3108AH on the inside of the top cover (see Fig.1) so that radiation exposure time equals the indicated time value, taking into consideration the accuracy tolerances; (3) replace the top cover and 4 screws.

Fig. 1



2. PEAK TUBE POTENTIAL

2-1 Test method:

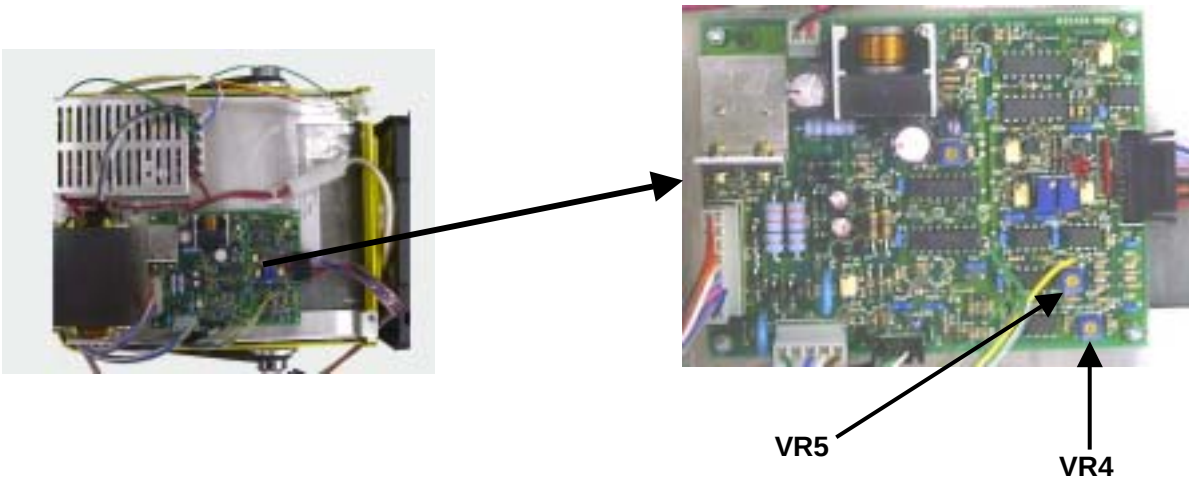
1. Set *HF100H* exposure timer to 0.2 sec., and set kV to 40 kV.
2. Set NERO to the following settings:
   SID: 18 inches; Wheel range: 27 ~ 42 kV; Sensitivity: Hi; Phase select: 3Ø;
   Measurement mode: SGL; X-ray values: 40 kV, 0.2 sec.
3. Make exposure and read the measured AVG. kV value on the NERO.
4. Measure also value of AVG. kV at 50 kV, 60 kV, 70 kV, 80 kV, 90 kV, and 100 kV with the following condition.
   50 kV, 60 kV (Wheel range: 35 ~ 60 kV; Sensitivity: Lo)
   70 kV, 80 kV (Wheel range: 50 ~ 85 kV; Sensitivity: Lo)
   90 kV, 100 kV (Wheel range: 70 ~ 120 kV; Sensitivity: Lo)

2-2 Instruments: NERO Model 6000M x-ray beam analyzer
Manufactured by Victoreen, Inc. or equivalent

2-3 Rejection limit: ±10%

If the peak tube potential needs adjustment: (1) remove the 4 screws on the side of the top cover of the *HF100H*, and lift the top off of the body of the unit; (2) adjust the potentiometer "VR4" on the printed circuit board M9112 located on top of the lower portion of the unit (see Fig. 2) so that peak tube potential equals the indicated kV value, taking into consideration the accuracy tolerances; (3) replace the top cover and 4 screws.

Fig. 2



3. TUBE CURRENT

3-1 Test method:

1. Set *HF100H* to 40 kV, and timer to 0.2 sec.
2. Set oscilloscope to the following settings.
   ch 1:Ep, ch 2:Ip, ch1 V/div: 1V, ch2 V/div: 500 mV, sec/div: 10 msec,
   trigger level: ch1 2.5 V
3. Open the top cover of the *HF100H* by removing the 4 screws and lifting the cover off of the unit. Connect ch 1 of oscilloscope to Ep pin of PC board M9112 and connect ch 2 of oscilloscope to Ip pin of PC board M9112. Connect GND line of probe to GND pin of PC board M9112.
4. Make exposure, and measure Hi value of ch 2. 2.0 V is equal to 20 mA.
5. Measure Hi value of ch 2 at 50 kV, 60 kV, 70 kV, 80 kV, 90 kV and 100 kV at 0.2 sec. with same procedure.

3-2 Instruments: Digital Storage & Analog Oscilloscope 2212
Manufactured by Tektronix Holland, N.V. or equivalent

3-3 Rejection limit: ±15%

If the tube current needs adjustment: (1) adjust the potentiometer "VR5" on the printed circuit board M9112 (see Fig. 2) so that tube current equals 20 mA, taking into consideration the accuracy tolerances; (2) replace the top cover and 4 screws.

4. If all *HF100H* functions are operating within specifications, proceed to the collimator light field to x-ray field alignment test. Instructions for performing this test and making any necessary adjustments are contained in the separate instruction manual for the collimator supplied with your *HF100H*.

MINXRAY INC.

INSTALLATION CHECK LIST

INSTALLATION CHECK LIST		*HF100H*	
	Fill out this checklist when installation is complete.	**SERIAL NO.**	
		DATE MANUFACTURED	
EQUIPMENT LOCATION			

TEST DESCRIPTION	**ACCEPTANCE LIMITS**	**RESULTS**	**CHECK**
Line Voltage	105~135 V or 200~260 V	…….V	☐ GO ☐ NO GO
Line Voltage Regulation	≤ 4.8%	…….%	☐ GO ☐ NO GO
Peak Tube Potential	40 kV±10% 50 kV±10% 60 kV±10% 70 kV±10% 80 kV±10% 90 kV±10% 100 kV±10%	…….kV …….kV …….kV …….kV …….kV …….kV …….kV	☐ GO ☐ NO GO
Tube Current	20 mA±15%	…….mA	☐ GO ☐ NO GO
Exposure Time	0.08 sec ±10%+1 msec. 0.1 sec ±10%+1 msec. 0.12 sec ±10%+1 msec. 0.2 sec ±10%+1 msec. 1.0 sec ±10%+1 msec.	…….sec …….sec …….sec …….sec …….sec	☐ GO ☐ NO GO
X-ray Field Alignment	See collimator Manual		☐ GO ☐ NO GO
All Mechanical Movement	Smooth Movement		☐ GO ☐ NO GO
All Operation	See operation Manual		☐ GO ☐ NO GO

Instruments Used	Manufacturer	Model	Accuracy	Last calibrated

Dealer Name	Dealer Phone Number
Dealer Address	
Assembler signature	Date
Comments	

OPERATION INSTRUCTIONS

IT IS ASSUMED BY THE DISTRIBUTORS AND MANUFACTURERS OF THIS EQUIPMENT THAT THE PERSON RESPONSIBLE FOR ITS OPERATION HAS A GENERAL KNOWLEDGE OF THE USE OF X-RAYS, INCLUDING THE SAFETY PRECAUTIONS THAT MUST BE TAKEN.

Operation

1. Make sure that the main POWER switch is OFF. Connect the AC power cord to a grounded electrical outlet. Check the label on the *HF100H* to confirm the rated AC input voltage and amperage required.

2. Turn on the POWER switch ON. The WARM-UP indicator will light.

3. Set the correct kV output for the view to be taken and the imaging medium used. Press the arrows below the kV display to choose the kV setting. 20 mA output is fixed at all kV settings.

4. Set the exposure time for the view to be taken, and the imaging medium used. Press the arrows below the sec. display to choose the exposure time.

5. Use the retractable tape measure on the collimator to position the *HF100H* at the proper source-image distance (SID) for the image to be taken.

6. Turn on the collimator light by pressing the button on the collimator. The light will remain on for approximately 30 seconds, then automatically turn off. The shutters of the collimator can be adjusted at any time with the 2 knobs on the collimator. The size of the radiation field will only be projected on the image receptor when the light is on.

7. Position the patient. Adjust the collimator position so the cross hair projected by the collimator light is aligned with the anatomical point of interest and the center of the image receptor. Collimate the size of the light field so that it stays within the dimensions of the image receptor.

8. There are two types of warning indicators on the *HF100H*: ERROR and WARM-UP. If either one of this is lighted, x-ray cannot be generated.

   a. WARM-UP indicator: The internal circuits have a warm-up time of approximately 10 seconds. The WARM-UP light will turn on after each exposure.

   b. ERROR indicator: This indicates a malfunction of the *HF100H*. If the ERROR light is on, release the exposure switch. An unusual situation has occurred on the inverter circuit. Turn the main POWER switch OFF and wait three (3) minutes before turning the power ON again. If the ERROR indicator remains lighted, please consult a qualified service technician or contact MinXray.

9. The exposure switch has a 2-stage button.

   The first stage pre-heats the filament for the x-ray tube. When this stage alone is depressed and held, the STAND BY indicator will light for approximately 1.5 seconds while the filament heats. When the STAND BY indicator turns off, the filament is heated and the *HF100H* is ready to generate x-rays.

   The second stage initiates the x-ray exposure for the time set in the SEC. display on the control. When the second stage is fully depressed, x-ray will be emitted, the X-RAY indicator will light, and an audible signal will be heard. PRESS AND HOLD THE FIRST AND SECOND STAGE BUTTONS TOGETHER UNTIL THE EXPOSURE HAS TERMINATED. This is a “dead man” exposure switch—x-ray will terminate immediately as a safety feature when the buttons are released.

   It is possible to depress the two stage buttons simultaneously. When this is done, there is approximately a 1.5 second delay before the timed x-ray exposure begins.

10. After each exposure, release the exposure buttons. The *HF100H* is now ready for the next exposure.

11. When you are finished using the *HF100H*, turn off the main POWER switch, disconnect the AC power cord, and put the stand with the *HF100H* attached into its correct configuration for transport.

Safety Precautions

1. During exposure the operator must stand as far as possible from the patient being x-rayed, and should wear a lead apron or stand behind a lead shield.

2. The operator must not stand in the primary x-ray beam.

3. The operator should wear a monitoring dosimeter while operating this unit. It should be worn where it is not covered by a lead apron.

4. X-ray exposure should be kept as short as possible.

5. The presence of radio frequency (RF) or electromagnetic radiation may adversely affect the operation of this device. Please keep this equipment away from likely sources of RF radiation.

Maintenance

Clean the *HF100H* as needed with a damp sponge or cloth and mild soap.

The following must be checked before each use:

Tubehead

1. Make sure the certification and identification labels are in place.

2. Check for any loose or missing screws, including the collimator mounting hardware.

3. Check for oil leaks.

4. Check for any physical damage.

5. Check the kV adjustment for proper operation.

6. Check the timer adjustment for proper operation.

7. Check collimator shutters for proper operation.

8. Check the collimator light bulb for proper operation.

9. Check all cords and cord connections.

10. Check the exposure buttons--the exposure must terminate if the button is released during an exposure.

Indicators

1. Check the X-RAY indicator for proper operation when both exposure buttons are depressed and held.

2. Make sure the audible signal operates during an exposure.

WARNING

Continued use of loose components is dangerous and could cause further loosening, damaged screws and bolts, or mount failure which could result in HEAVY COMPONENTS FALLING DURING USE. The operator should report all loose system components or any other problems to qualified service personal for immediate repair.

The following must be checked every six (6) months:

1. Check the collimator light field to x-ray field alignment.

2. Check the kV output (refer to page 9 - Peak Tube Potential).

3. Check the mA output (refer to page 10 - Tube Current).

4. Check the timer accuracy (refer to page 8 - Exposure Time).

Have this unit check by qualified x-ray service personnel immediately if any problems occur with the *HF100H*. MinXray can supply detailed technical service and parts information to qualified service personnel upon request.

The following must be checked every two (2) years:

The *HF100H* should be tested for Leakage Radiation by qualified service personnel.

MinXray can supply detailed technical service and parts information to qualified service personnel upon request.

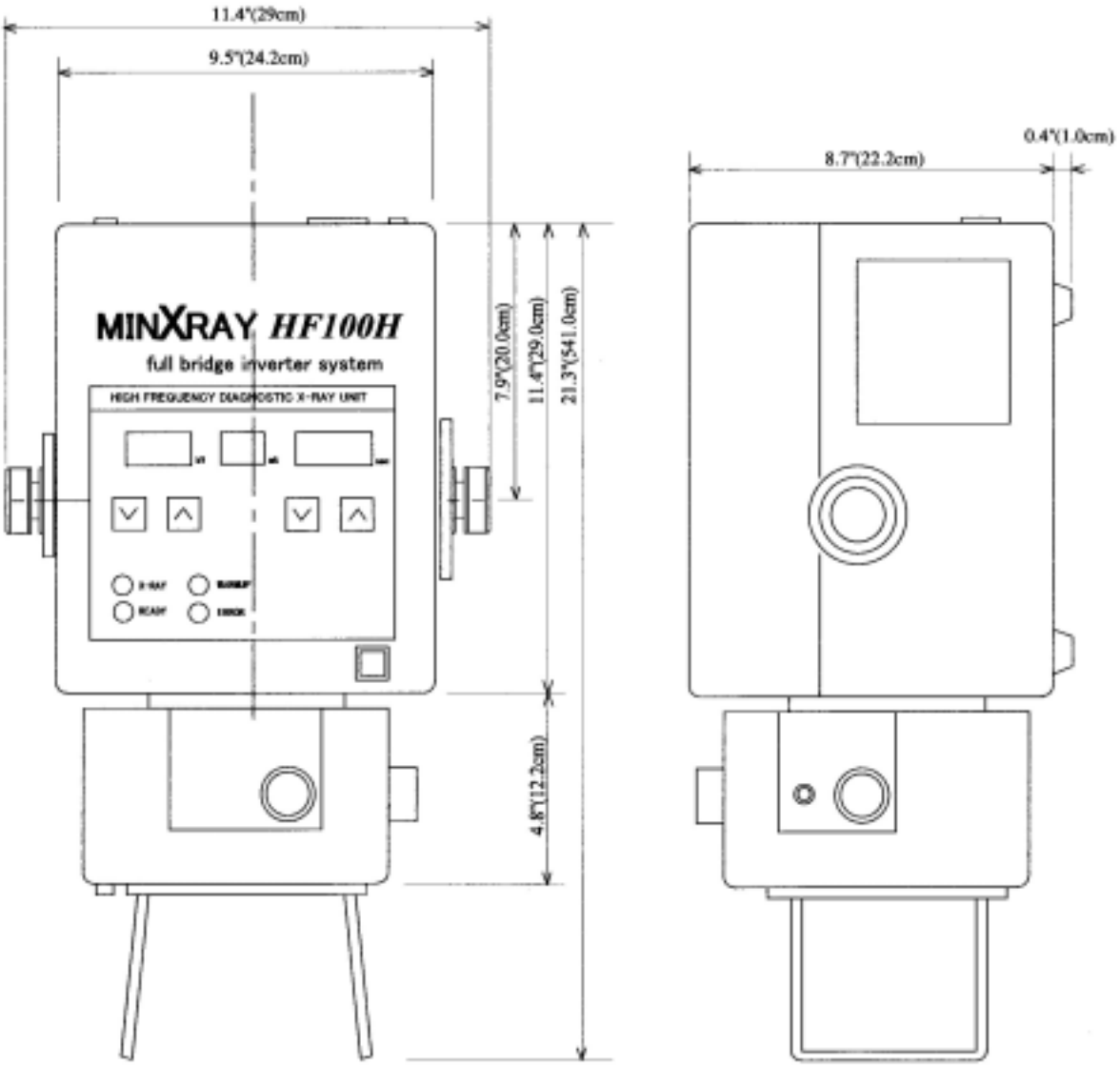
MINXRAY INC

MinXray *HF100H* SPECIFICATIONS

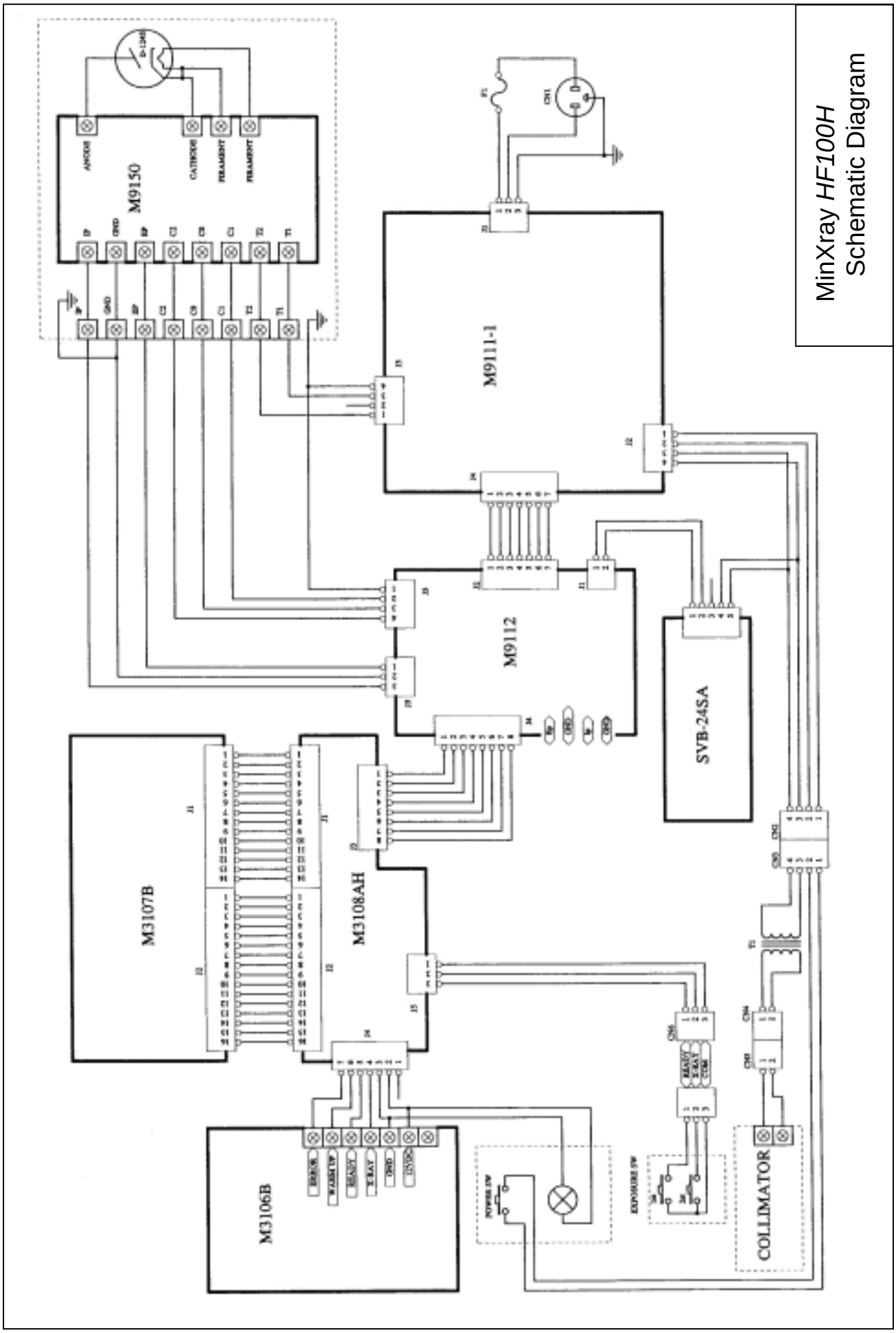
Maximum peak tube potential :	100 kV ±10%
Leakage technique factors : 0.65 mA is maximum rated continuous current for 20 mA with duty cycle 1:30	100 kV, 0.65 mA
Filtration (without collimator) : Total Filtration :	2.2 mm Al equivalent at 100 kV 4.2 mm Al equivalent at 100 kV
Range of line voltage compensation :	105 ～ 135 VAC, 50/60 Hz or 200 ～ 260 VAC, 50/60 Hz, depending on model ordered
Fuse :	30 A @ 105 ～ 135 V (on outercase) 20 A @ 200 ～ 260 V (on outercase)
Line voltage regulation :	4.8%
Generator rating :	20 mA at 100 kV ±15% 20 mA at 40 kV ±15%
Exposure timer :	0.08 ～ 4.00 sec. ±10% + 1 msec.
Duty cycle :	1 : 30 (1 sec. On, 30 sec. Off)
Preheat time :	Approximately 2 sec.
Warm up time :	Approximately 10 seconds after each exposure and after the initial Power On
Maximum deviation from fixed factors :	Tube potential ±10% Tube current ±15%
X-ray tube :	Toshiba D-124S or equivalent
Focal spot size :	1.2×1.2 mm
High voltage circuit output :	60 kHz high frequency inverter system with neutral ground circuit
Filament :	Inverter system
Collimator :	Advantech R72/32 or equivalent
Weight (including collimator) :	40.5 lbs. (18.4 kg)
Dimensions :	9.5”(24.2 cm) W x 8.7”(22.2 cm) H x 16.2”(41.2 cm) L

Specifications subject to change without notice.

DIMENSIONS



Dimensions subject to change without notice


MinXray *HF100H*
Schematic Diagram
M9150
M9111-1
M9112
SVB-24SA
M3107B
M3108AH
M3106B
COLLIMATOR

TOSHIBA

Electron Tube, Device & Equipment
TECHNICAL DATA

TOSHIBA X-RAY TUBE
D-124,D-124S

STATIONARY ANODE X-RAY TUBE

- ◆ Especially designed for portable X-ray unit.
- ◆ Provided with an insulation cylinder.(D-124S)
- ◆ These tubes have focus 1.2 mm, and are available for maximun tube voltage 100 kV with self-rectified and DC or 110 kV with single phase full-wave rectified circuit.
- ◆ Installed in the same enclosure with the high tension transformer.

GENERAL DATA

ELECTRICAL:

Circuit(Center-grounded)	Self-rectified,Single phase full-wave rectified or DC	
Operating Tube Voltage	Self-rectified	50 to 100 kV
	Full-wave rectified ...	50 to 110 kV
	DC	50 to 100 kV
Focal Spot		1.2 mm
Input Energy(at 1.0s):		
See rating charts.....	Self-rectified	1130 W
	Full-wave rectified	1780 W
	DC	2400 W

MECHANICAL:

Dimensions	See dimensional outline.	
Overall Length:		
D-124		111 mm
D-124S		130 mm
Max. Diameter:		
D-124		41 mm
D-124S		48 mm

★ The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others.
★ The information contained herein may be changed without prior notice. It is therefore advisable to contact TOSHIBA before proceeding with the design of equipment incorporating this product.

TOSHIBA CORPORATION

No.TE-D-124・D-124S 1994-04-18

Target Angle ..... 16 degrees
Inherent Filtration ..... At least 0.8mm Al equivalent at 50 kV
X-ray Coverage ..... 354 x 354 mm at SID 750 mm
Weight (approx.):
    D-124 ..... 180 g
    D-124S ..... 265 g
Cooling Method ..... Oil immersed (60℃ Max.) and convection oil cooling
Tube Holding:
    D-124 ..... Holding the glass envelope of the anode end and cathode end, or the screw of the anode shank
    D-124S ..... Holding the insulation cylinder

ABSOLUTE MAXIMUM AND MINIMUM RATINGS

(At any time,these values must not be exceeded.)

Max. Tube Voltage ..... Self-rectified ..... 100 kV
                        Full-wave rectified ..... 110 kV
                        DC ..... 100 kV
Max. Inverse Tube Voltage ..... 105 kV
Min. Tube Voltage ..... 50 kV
Max. Tube Current:
    See rating charts. ..... Self-rectified ..... 20 mA
                             Full-wave rectified ..... 40 mA
                             DC ..... 40 mA
Max. filament Current ..... 3.1 A
Filament Voltage:
    At max. filament current ..... 2.7 to 3.6 V
Thermal Characteristics:
    Anode Heat Storage Capacity ..... 14 kJ (20 kHU)
    Max. Anode Heat Disipation Rate ..... 180 W (250 HU/s)

HF100H TUBE HOUSING COOLING CURVE